実践論文

選択実験のチェックボックス位置効果検証
- ユーグレナ食品に関する学生調査を事例として -
The Checkbox Positioning Effect on Choice Experiments
- Evidence from a Japanese Undergraduate Survey on Food Containing Euglena -

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近年，極めて多くの選択実験（choice experiment: CE）適用事例が蓄積されている一方で，CE において回答者に提示するチェックボックスの位置効果については検証されてこなかった．そこで，ユーグレナを含む仮想的なガムに対する学生選好調査において，CE のチェックボックス位置効果を検証した．CE の属性として，上から順に，ガムに含有される成分（カルシウム・ビタミン・ユーグレナ），ガムを推薦している情報源（ネット・友人・トクホ），成分の含有量，14 ケ入り価格を設定し，上下それぞれにチェックボックスを配置したサブサンプル間で推定結果に異同が生じるかを観察した．分析の結果，一番上に配置した選択セット属性のみにチェックボックス位置効果が観察され，アイトラッカーや潜在クラスモデル，属性情報の非処理に関する質問項目設定などでさらに効果の検証を行うべきであり，あるいはチェックボックスと価格属性の双方を選択セットの一番下に配置することが推奨される結果となった．

While choice experiment (CE) techniques are found in a range of contexts, the checkbox positioning effect has not been investigated, which may lead to a certain design 'flaw' in questionnaires. In order to test the impact of the checkbox positioning effect on CEs, we conducted a survey on a hypothetical chewing gum that includes Euglena (microalgae) using a sample of undergraduates at Dokkyo University. Our CE questions relate to the nutritional-content attributes of the chewing gum: calcium, vitamins, Euglena; recommendations about the chewing gum from the Internet, from friends, from 'tokuho' labels certified by Japanese authorities; nutritional content; and the price of the gum, vertically fixed in this order into the choice set. We then separate our sample of undergraduates into those provided with checkboxes above and below the CE questions. We find that there is certain checkbox positioning effect on only the top attribute of CE questions. This suggests that there is a need for further research on the reason for the effect using eye trackers, latent class models, or stated ignorance by respondents to examine the relationship between checkbox positioning and the ignoring of attributes. Alternatively, we should set the checkboxes below the choice sets along with the bottom-placed price attribute.

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1. Introduction

In order to elicit preferences in many contexts, including marketing, transportation, the environment, resources, and health economics, choice modeling (CM) techniques, as a stated preference approach, have been frequently utilized, while the revealed preference method has also been employed (Louviere et al. 2000). The revealed preference method, which includes the hedonic price function approach, has high reliability because it utilizes behavioral data in existing markets. However, it suffers from multicollinearity between covariates, relatively low flexibility because it analyzes existing alternatives, and relatively low data availability, especially in developing countries. In contrast, the stated preference method, which includes CM, describes hypothetical behavior, such that it has relatively high flexibility, and can cope with multicollinearity using certain experimental design procedures. In particular, choice experiment (CE) techniques, wherein respondents select the most preferred type from alternatives, occur in many contexts, with the expectation that the application ranges and instances of CM/CE will become increasingly extended.

While CM/CE techniques apply increasingly in many contexts, there are many methodological issues to be resolved, one being ordering or positional effects. For example, Chrzan (1994) suggested that there are three positional effects in CM, these being the order of choice sets, the order of profiles or alternatives within these choice sets, and the order of attributes within these profiles. However, while the design of CM/CE questions includes decisions on the placing of checkboxes, with the exception of Ohdoko (2014) and best–worst scaling, no known studies consider the checkbox positioning effect on these techniques. We were especially unable to identify any research on this effect in CE questions. This is important because eye movements or visual features can influence CE responses, which can lead to a certain design 'flaw' in the survey instrument. Therefore, we decided to conduct our research on the checkbox positioning effect on CEs using a sample of undergraduate students as a pilot study.

The article proceeds as follows. In Section 2, we summarize previous studies on the research issues associated with CE questions. In Section 3, we explain our survey design and the econometric methods employed. In Section 4, we present and discuss the estimation results. Finally, in Section 5 we provide some concluding remarks along with some topics for future research.

2. Literature Review

While CE techniques increasingly apply in many contexts, many methodological issues remain unresolved. We categorize these as falling into two main areas: psychological issues and survey instrument design. Psychological issues are frequently studied. Because CEs utilize hypothetical scenarios to measure preferences in the 'real world,' hypothetical bias has been seen as one of the main problems to be solved (Lusk and Schroeder 2004; Chang et al. 2009; Lusk et al. 2008; Mitani and Flores 2009; Hensher 2010). Some research has focused on the framing effect, whereby respondents react in different ways to loss and gain framing, a feature known as loss aversion (Hess et al. 2008; Howard and Salkeld 2009). Other studies have examined the phenomenon of attribute nonattendance, where respondents only attend to some of the attributes in the CE choice

set. This is one of the heuristics of processing information (Hensher et al. 2005; Colombo et al. 2013; Hess et al. 2013; Hole et al. 2013; Kehlbacher et al. 2013; Lagarde 2013; Balcombe et al. 2015; Glenk et al. 2015; Nguyen et al. 2015). While it is certain that we can ultimately solve such psychological challenges, survey instrument design should also be studied because CEs are a social survey instrument.

Many other fields of research have also been the subject of attention. For instance, to estimate preferences efficiently, there is experimental design in the context of designing CE questions (Kanninen 2002; Sándor and Wedel 2002; Lusk and Norwood 2005; Sándor and Wedel 2005; Kessels et al. 2006; Raghavarao and Wiley 2006; Ferrini and Scarpa 2007; Street and Burgess 2007; Louviere et al. 2008; Scarpa and Rose 2008; Yu et al. 2008; Louviere et al. 2011; Carson et al. 2009; Bush et al. 2012). The CE question approach includes choice sets such as those found in the Appendix of this paper. The choice set size, that is, the number of alternative, relates to the informational burden of choice sets for respondents (Bech et al. 2011; Schaafsma and Brouwer 2013). The opt-out option in choice sets has also been a major topic of research (Burton and Rigby 2009; Vermeulen et al. 2008; Fenichel et al. 2009; Hwang et al. 2014; Veldwijk et al. 2014). In a contingent valuation method, which is one of the stated preference approaches, Groothuis and Whitehead (2002) found that whether 'don't know' responses are similar to 'no' responses depends on the scenario design, i.e., whether it is a willingness-to-pay study or a willingness-to-accept study.

Because CM/CE methods include social survey features, there is also the question of ordering or positional effects, which are known to occur frequently in social survey instruments. In CM contexts, Chrzan (1994) suggested that there are three positional effects in the CM, these being the choice set order, the order of profiles or alternatives within choice sets, and the attribute order within profiles, and recommended that profile and attribute orders should be rotated. Scott and Vick (1999) conducted a CE study in Scotland to elicit patients' preferences regarding doctor–patient relationships, and found that one attribute ('being able to talk' with the doctor, which was assumed to be valued positively) was influenced by the attribute order effect. This suggests that the later the attribute is provided, the more preferred it is by respondents.

Farrar and Ryan (1999) elicited hospital consultant preferences for potential clinical service developments in the UK with CE. They employed CE questions without a certain price attribute, and found that there were no attribute order effects. Kjær et al. (2006) implemented a CM study on Danish patient preferences for psoriasis treatment. They suggested that respondents are more price-sensitive when the price attribute is placed at the bottom of the choice set, which leads to 'conservative' (that is, lower) willingness-to-pay (WTP) estimates. Ohdoko and Yoshida (2012) found no attribute order effects on nonprice attributes of Japanese residential CE questions concerning management of forest species diversity. As a whole, it would seem that we do not have to be concerned about the attribute order effect, apart from that concerning the price attribute.

Despite the fact that choice sets, profiles, and attribute order effects have attracted attention in many contexts, there are no known studies focusing on the checkbox positioning effect on CM questions. The only exception is Ohdoko

(2014), who examined the impact on best–worst scaling (BWS) in Japan, one of the CM techniques (Hess and Daly 2015). Ohdoko (2014) found that a certain checkbox positioning effect exists when estimating the coefficients of variation of item importance in the BWS, such that we should rotate checkbox position laterally in BWS questions as much as possible. Ohdoko (2014) indicated that the left-to-right Japanese lateral writing system influences BWS responses, citing Dobel et al. (2007), who suggested that certain writing systems influence positioning bias. As the Japanese lateral writing system is left-to-right, and proceeds vertically in a top-to-bottom direction, it is almost certain that Japanese readers are accustomed to moving their eyes from left to right and from top to bottom. Especially in the context of survey research in Japan, survey instruments frequently employ a lateral writing system, therefore the lateral writing system seems to influence CE questions.

In addition, because it is common to place checkboxes for CM questions below the choice set (see the Appendix), eye movement or visual features can influence the CM response, which can lead to a certain design 'flaw' in CM survey instruments. Indeed, it is increasingly common to combine CM with eye-tracking techniques to examine eye movement or eye fixation in order to better understand survey responses and behavioral features relating to CM (Meißner and Decker 2010; Orquin et al. 2013; Vidal et al. 2013; Behe et al. 2014; Bialkova et al. 2014; Balcombe et al. 2015; Rasch et al. 2015). Because checkbox position can become a visual feature of CM questions and influence the eye movement of respondents, we should investigate whether there are positioning effects and if so, how they operate.

3. Materials and Methods

Nowadays, microalgae such as euglena are receiving increasing attention with regard to human consumption. While Mata et al. (2009) reviewed the development and generation of biofuels from microalgae, new food product development containing euglena is being increasingly investigated in Japan (Redmond 2015). Euglena contains many nutritional compounds, such as paramylon, vitamins, calcium, and so on. As functional food labeling has been permitted since April 2015 in Japan, there is substantial potential to diffuse or deploy euglena foods, especially in Japanese markets.

When it comes to developing brand-new food products, it is inevitable that there is a need to conduct marketing research. Krystallis et al. (2010) suggested the usefulness of a hypothetical CE to predict the latent market structure or consumer preferences for new food products. In order to demonstrate this in the Greek market, Krystallis et al. (2010) utilized three kinds of functional children's snacks: savory puffs, chips, and croissants. Larue et al. (2004) also conducted a CE survey on food with a functional health benefit along with genetically modified food production, suggesting that organic functional food will be profitable in Canada. In order to assess whether Japanese food consumers will accept brand-new Euglena foods, we decided to employ a CE technique to elicit consumer preferences. As a pilot study, we designed our survey using a sample of undergraduate students studying at Dokkyo University in Japan. To enable undergraduate respondents to easily understand our CE scenario, we employed the example of a hypothetical functional chewing gum.

We administered our survey at Dokkyo

University from April 4th to 28th, 2015. Before implementation, we conducted preliminary discussions with six undergraduates attending a Taro Ohdoko Seminar at Dokkyo University to design the questionnaire and to select the attributes of CE questions, and we conducted a pretest session to improve the quality of the questionnaire using 14 undergraduates in another Taro Ohdoko Seminar[1]. We decided to conduct an in-person self-administered CE survey to elicit the preferences for attributes of chewing gum including type of nutritional content, recommendations from certain information sources, amount of nutritional content, and the price of the gum, attributes we assumed undergraduates would care about in selecting a chewing gum.

We then selected the levels of attributes, as shown in Table 1. For nutritional content, we selected calcium, vitamins, and Euglena. The levels of the first two were assumed to be familiar to Japanese undergraduates. As to recommendations from certain information sources, we selected three levels to mimic the actual situation of undergraduates, these being information on the Web such as Internet news and blogs, information from their friends, and information from the 'tokuho' (short for 'tokutei hokenyou shokuhin' or foods with special healthy qualities) label certified by the Japanese Ministry of Health, Labor, and Welfare[2]. As to the amount of nutritional content and the price of the gum, we selected levels to mimic the actual situation in the Japanese market. It is clear that CE performance depends on respondents interpreting the questionnaire correctly. Thus, we simplified our questionnaire as much as possible.

We organized our questionnaire as follows. First, we collected demographic variables, including student gender, age, faculty, and department. Second, we provided information on Euglena, including its definition, nutritional content, and health benefits. We then asked respondents whether they had heard about these before participating in our survey, and whether they understood our interpretation. Third, we provide our hypothetical scenario (see the Appendix) and eight CE questions along with a sample answer. Finally, we collected attitudes on whether the respondents were prone to buying brand-new commodities and their 'food-style' scale (Satomi et al. 2006) as their lifestyle covariates with regard to food. In addition, we collected responses about whether they normally buy at least some gum.

In creating the CE choice sets, we eliminated any possible correlation with the attributes in the experimental design methodology, primarily by using the main effects of a fractional factorial design along with the attributes and levels given in Table 1 in order to reduce the number of combinations below the maximum factorial $3^4=81$ (Lorenzen and Anderson 1993). We created 16 profiles, and randomly selected two of these to create our choice sets. For simplicity, we fixed the attribute order as nutritional content, recommendations, the amount of nutritional content, and price, from top to bottom. Including an opt-out option makes it possible to mimic real-world situations (Ryan and Skåtun 2004). Thus, we provided two alternatives and one opt-out option for each CE question, which represented eight choices per respondent in

[1] There were 20 undergraduates in the Taro Ohdoko Seminar, of which we used 14 after excluding those with whom we had preliminary discussions in the pretest session.

[2] http://www.mhlw.go.jp/topics/bukyoku/iyaku/syoku-anzen/hokenkinou/hyouziseido-1.html [Japanese only, retrieved on September 30th 2015].

	□	☑	□
	M	N	L
Type of nutritional content	Euglena	Vitamins	I cannot choose between the two alternatives.
Recommended by	Web	Friends	
Amount of nutritional content (mg)	300 mg	200 mg	
Price (JPY/pack)	JPY 110	JPY 130	

Fig. 1: Example of Responses for Sample A

	M	N	L
Type of nutritional content	Euglena	Vitamins	I cannot choose between the two alternatives.
Recommended by	Web	Friends	
Amount of nutritional content (mg)	300 mg	200 mg	
Price (JPY/pack)	JPY 110	JPY 130	
	□	☑	□

Fig. 2: Example of Responses for Sample B

Table 1: Attributes and levels of CE

Attribute (unit)	Levels
Type of nutritional content	Calcium, Vitamins, Euglena
Recommended by	Web, Friends, Tokuho
Amount of nutritional content (mg)	100, 200, 300
Price (JPY/pack)	90, 110, 130

accordance with incorporating a "too close to call option" as in Fenichel et al. (2009)[3].

We sampled as many undergraduates at Dokkyo University as possible using convenience sampling and campus street intercepts. We distributed our 8-item survey questionnaires to 200 undergraduates and obtained 168 effective responses incorporating 1,343 useful observations (the response rate was 84%). In order to test the checkbox positioning effect, we created two split samples: those who were provided with CE questions in which the checkboxes were placed above the choice sets (sample A), and those where they were placed below the choice sets (sample B). In Figures 1 and 2, we provide examples of the items in samples A and B, respectively, that were utilized in our questionnaires. Table 2 shows the demographics of our sample, while Table 3 shows the respondents' attitudes[4].

To analyze the CE data, we employ a random utility model where we define the utility of the respondent choosing alternative i as:

$$U_i = V_i + \varepsilon_i = \beta' x_i + \varepsilon_i, \qquad \text{(Eq. 1)}$$

where V_i denotes the observable component, ε_i is the unobservable error component, and x_i is the attribute vector of alternative i, which has the marginal utility vector β (Louviere et al. 2000). Previous studies have frequently employed an additively separable form for the observable component, which we also utilize[5].

[3] It is difficult to translate 'too close to call' in Japanese. Instead, we utilized the expression 'I cannot choose between the two alternatives.'

[4] In order to utilize every covariate of the respondents, we employed only fully answered responses. We could not identify which respondents were sampled using convenience sampling or campus street intercepts.

[5] We also employed a linear form of the utility function with regard to the attributes in the choice set.

Table 2: Demographics

Item	Subitem	Sample A	Sample B	P-value
No. of samples		82	86	
Gender	Male	43	37	0.279
	Female	39	49	
Age (in years)	18	9	6	0.883
	19	32	36	
	20	31	30	
	21	8	10	
	22	2	3	
	23	0	1	
	Mean	19.537	19.663	
	SD	0.905	0.978	
Faculty	Foreign Languages	32	31	0.632
	International Liberal Arts	5	10	
	Economics	31	33	
	Law	14	12	
About Euglena				
Had heard about it before participating	Yes	9	11	0.814
in our survey	No	73	75	
Understand our interpretation	Yes	73	78	0.801
	No	9	8	
Normally purchase chewing gum	Yes	36	32	0.433
	No	46	54	

Notes: SD is standard deviation. P-values estimated using Fisher's exact test. The numbers in the third and fourth columns are the number of samples (except the mean and standard deviation of age).

McFadden (1974) showed that the choice probability of i among J alternatives becomes a conditional logit (CL) with random utility maximization given a Type I extreme value distribution for the error component, as follows:[6]

$$P_i = \exp(V_i)/\sum_j \exp(V_j). \quad \text{(Eq. 2)}$$

Revelt and Train (1998) demonstrated that a random parameter logit (RPL) with the use of repeat data to estimate the choice probability with preference heterogeneities could relax the assumptions of CL, i.e., preference homogeneity and the independence of irrelevant alternatives (IIA). [7] The choice probability of respondent n ($n = 1, \cdots, N$) is given as follows within the parameter space Ω:

$$\pi_{ni} = \int \prod_t P_{nit}\, f(\beta|\Omega)d\beta, \quad \text{(Eq. 3)}$$

where t ($t = 1, \cdots, T$) denotes the number of times the respondent answers, P_{nit} is the form of CL, and $f(\beta|\Omega)$ is known as a mixing distribution. Previous studies have frequently employed the normal distribution for $f(\beta|\Omega)$, which we also utilize. When employing RPL, the marginal utility parameter vector, β, becomes:

$$\beta = \tilde{\beta} + \sigma z, \quad \text{(Eq. 4)}$$

where $\tilde{\beta}$ and σ denote the mean and standard deviation parameter vector of β, while z is an independently and identically distributed vector, for which we assumed the standard normal

[6] This assumes a strictly increasing, continuous, and strictly quasi-concave utility function.

[7] For any two alternatives i and k, the IIA property of CL in Eq. 2 is equivalent to the ratio of the probabilities not depending on any alternatives other than i and k ($P_i/P_k = \exp(V_i)/\exp(V_k)$, see, e.g., Train (2009)). With RPL, the ratio of the probabilities becomes: $P_{nit}/P_{nkt} = \int \prod_t \exp(V_{nit})/\sum_j \exp(V_{njt})\, f(\beta|\Omega)d\beta \,/\, \int \prod_t \exp(V_{nkt})/\sum_j \exp(V_{njt})\, f(\beta|\Omega)d\beta$. Then, the ratio depends on all alternatives other than i and k, and IIA is totally relaxed by RPL.

distribution. We can capture preference heterogeneities by the standard deviation parameter vector σ. In this article, we assume that z is uncorrelated across individuals, as is frequently assumed for simplicity.

In order to test the checkbox positioning effect, we pooled samples A and B, and then incorporated the sample B dummy variable in the cross-terms of attribute variables in the choice set when estimating the observable utility component, V_i, as follows:

$$V_i = \beta' x_i + \gamma' x_i \times D_B, \text{ (Eq. 5)}$$

where D_B is the sample B dummy variable and takes a value of one if the respondent belongs to sample B and 0 otherwise, and γ denotes the coefficient vector of the checkbox positioning effect.

We employ R 3.2.2 (R Core Team 2015) and the procedure 'mlogit' when estimating RPL. We set alternative specific constants (ASCs) for the leftmost and middle options in the choice set to test for alternative positional effects, as pointed out by Chrzan (1994)[8]. As the rightmost option in the choice set denotes the opt-out option, this option is not preferred when every ASC is positively and significantly estimated. We employed effects coding for the qualitative variable in our choice sets in accordance with Louviere et al. (2000) and Bech and Gyrd-Hansen (2005)[9]. We decided to estimate two models. In Model 1, we treated as numerical variables the attributes amount of nutritional content and price. In Model 2, we treated every level of attribute as a qualitative variable.

In searching for the best-fit model for RPL, we gave a high priority to the significance of the standard deviations of the parameters in order to grasp the structure of the preference heterogeneities in the first place. In estimating, we employed several measures, including the Akaike information criterion (AIC), the corrected AIC, and the Bayesian information criterion (BIC).

4. Results and Discussion

Before estimating the CE results and testing the checkbox positioning effect, we checked the homogeneities of the covariates between the split samples. First, we checked sample homogeneity within the demographics employing Fisher's exact test (the fifth column in Table 2). We were unable to reject the null hypothesis, and therefore we conclude that samples A and B are identical in terms of sample demographics at least at the 0.10 level of significance. Second, we checked for attitudes (the fifth column in Table 3). As with most of the items, sample homogeneity was not statistically rejected, except for the food-style scale item "I often enjoy a meal more when I am in a place with good atmosphere". Indeed, as the empirical distribution of the item appeared to be the same qualitatively, we decided to assume that all of the covariates were statistically identical across the subsamples

Table 4 presents our CE variables, and Table 5 presents the RPL results. The likelihood ratio test statistics are substantially larger than the critical value (Model 1: $405.740 > \mathrm{Chi}^2_{0.05}(14) = 23.685$; Model 2: $358.130 > \mathrm{Chi}^2_{0.05}(20) = 31.410$).

First, we briefly interpret the ASC and standard deviation parameters. We obtained positive and

[8] Scarpa et al. (2005) suggested that the error component model, which is a random parameter logit model, displays robustness along with the status quo effect. Although we decided to estimate simply by introducing the maximum number of ASC to capture the effect of our opt-out option, it remains a topic for future research.

[9] When the level of the qualitative variable is $l = 1, 2, \cdots, L$, and the arbitrarily omitted level is L, then the parameter of the omitted level, β_L, is estimated by the negative sum of the parameters of the remaining levels: $\beta_L = -\sum_{m \neq L} \beta_m$.

significant ASCs for both Model 1 and Model 2. This indicates that our opt-out option is not

Table 3: Attitudes

		Sample A	Sample B	P-value
Attracted by brand-new things				
I am attracted by commodities labeled 'limited-time offer'	Mean	4.000	4.070	0.704
	SD	1.042	0.905	
I am attracted by brand-new commodities	Mean	3.902	3.953	0.458
	SD	0.964	0.969	
I am attracted by commodities containing brand-new nutrients	Mean	2.768	3.023	0.326
	SD	1.158	1.095	
Food-style scale from Satomi et al. (2006)				
It is enjoyable to have a meal with my friends	Mean	4.610	4.593	0.783
	SD	0.698	0.602	
It is very important to have a meal together with other people in order to create relationships	Mean	4.610	4.512	0.639
	SD	0.681	0.699	
I often enjoy a meal more when I am in a place with good atmosphere	Mean	4.524	4.419	0.035**
	SD	0.933	0.774	
I find it enjoyable to have a meal with many other people	Mean	3.866	4.105	0.415
	SD	1.141	0.946	
I frequently have conversations when eating a meal	Mean	3.732	3.895	0.760
	SD	1.031	0.983	
It is enjoyable to have a meal with my family members	Mean	4.037	4.163	0.672
	SD	0.999	0.866	
I have meals regularly	Mean	2.988	2.942	0.442
	SD	1.171	1.141	
I take nutritional balance into consideration	Mean	3.012	2.814	0.323
	SD	1.160	1.057	
It is common for me to have a meal with my family members	Mean	3.000	2.907	0.947
	SD	1.370	1.360	
I have meals to let off steam	Mean	3.341	3.256	0.427
	SD	1.317	1.140	
In daily life, I look forward to having a meal	Mean	3.598	3.709	0.680
	SD	1.064	0.931	
I frequently eat until I am full	Mean	3.707	3.605	0.182
	SD	1.036	0.961	
I am particular about food safety	Mean	3.378	3.581	0.761
	SD	1.118	1.046	
I care about a food's expiration date	Mean	3.561	3.698	0.583
	SD	1.123	1.064	
I like to have food that is said to be good for health	Mean	3.171	3.291	0.440
	SD	1.142	0.981	

Note: SD is standard deviation. P-values estimated using Fisher's exact test. ** indicates significance at the 5% level. We coded the responses as follows: 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree.

Table 4: List of variables

Variable	Content	Description
$Sample_B$	The dummy variable indicating sample B	Takes a value of 1 if the respondent belongs to sample B; 0 otherwise
ASC_M	Alternative specific constant of option M	Takes a value of 1 if the chosen alternative is the leftmost option M; 0 otherwise
ASC_N	Alternative specific constant of option N	Takes a value of 1 if the chosen alternative is the middle option N; 0 otherwise
Calcium	The type of nutritional content is calcium	Estimated value from other effect-coded variable estimates
Vitamins	The type of nutritional content is vitamins in general	Takes a value of 1 if the chosen alternative contains this level of the nutritional content; –1 if it contains the level for 'Calcium,' which is an omitted variable; 0 otherwise
Euglena	The type of nutritional content is Euglena	Takes a value of 1 if the chosen alternative contains this level of nutritional content; –1 if it contains the level for 'Calcium,' which is an omitted variable; 0 otherwise
Friends	The information source making the recommendation is friends of the respondent	Estimated value from other effect-coded variable estimates
Web	The information source making the recommendation is Internet news and/or blogs	Takes a value of 1 if the chosen alternative contains this level of information source; –1 if it contains the level for 'Friends,' which is an omitted variable; 0 otherwise
Tokuho	The information source making the recommendation is 'tokuho' labeling	Takes a value of 1 if the chosen alternative contains this level of information source; –1 if it contains the the level for 'Friends,' which is an omitted variable; 0 otherwise
Amount	The amount of nutritional content	Numerical value
100mg	The amount of nutritional content is 100 mg	Estimated value from other effect-coded variable estimates
200mg	The amount of nutritional content is 200 mg	Takes a value of 1 if the chosen alternative contains this level of the information source; –1 if it contains the level for '100 mg,' which is an omitted variable; 0 otherwise
300mg	The amount of nutritional content is 300 mg	Takes a value of 1 if the chosen alternative contains this level of the information source; –1 if it contains the level for '100 mg,' which is an omitted variable; 0 otherwise
Price	The price of a pack of chewing gum with 14 pieces	Numerical value
JPY90	The price of a pack of chewing gum with 14 pieces is JPY 90	Estimated value from other effect-coded variable estimates
JPY110	The price of a pack of chewing gum with 14 pieces is JPY 110	Takes a value of 1 if the chosen alternative contains this level of the information source; –1 if it contains the level for 'JPY 90,' which is an omitted variable; 0 otherwise
JPY130	The price of a pack of chewing gum with 14 pieces is JPY 130	Takes a value of 1 if the chosen alternative contains this level of the information source; –1 if it contains the level for 'JPY 110,' which is an omitted variable; 0 otherwise

preferable for respondents, and we could capture the alternative position effect with ASCs. Then, we obtained significant standard deviation parameters in the choice set (standard deviation parameters are shown in Table 5). In both models, the standard deviation parameters for Euglena and Tokuho are labeling. The parameters for Amount in Model 1 and 300 mg in Model 2 are significant, which reflects the attitudes of food-style scale in Table 3 and/or unobserved heterogeneous preference for significant, which reflects the familiarity and/or unobserved opinions regarding Euglena and Tokuho nutritional content. The parameters for Web and JPY 130 in Model 2 are significant, which indicates that there are certain heterogeneities in preferences on information source and price.

On the checkbox positioning effect, we obtained a significant result on only the cross-term of Euglena in both models. The mean parameter for Euglena×Sample_{B} is significantly positive, which indicates that the respondents with the checkbox set *below* the choice set evaluate Euglena positively. However, the estimated mean parameter for Euglena itself is not significant, which indicates that respondents with the checkbox set *above* the choice set either have no preference for, or have not processed information on, the attribute level Euglena in the sense of attribute nonattendance. As the mean parameter is not significant for the other level of 'Type of nutritional content,' being Vitamins, and we fixed it on the top of the choice set, a certain amount of attribute nonattendance occurred. This suggests that we can alleviate attribute nonattendance when we place the checkbox *below* the choice set with the price attribute on the bottom in our case.

For the attribute 'Recommended by,' the estimated parameters were significant in both models. As to the level Web, this estimate was negative, which indicates that respondents do not prefer to obtain recommendation information on foods from Internet news or blogs. This suggests that food marketing should not rely on Internet news or blogs to obtain undergraduate student customers. When deploying brand-new food commodities, we should seek another Web channel such as private social networks or virtual recommendation agents. As to the level Tokuho, the estimate is positive, suggesting that respondents prefer to obtain recommendation information from the Japanese authorities. When deploying brand-new food commodities, we should pay considerable attention to using labels authorized by governmental agencies. The other level, Friends, is significant and positive. This suggests that a personal recommendation from friends has a positive effect on deploying brand-new commodities among the undergraduate community.

In terms of the estimated parameters for the attribute 'Amount,' these were significant in both models. In Model 1, the parameter Amount was significantly positive, while the parameters 200 mg and 300 mg were significantly positive in Model 2, with the size of the coefficient increasing as the amount increases. In addition, the parameter for 100 mg has a significantly negative value. The managerial implication is that a greater amount of nutrition should be contained within the brand-new food product. However, we could not compare the scientific information with the nutritional content intake in the choice set. Thus, as a political implication, the relevant authorities should insist on food labeling with scientific information on the necessity of a daily intake. For the parameter of the attribute 'Price,' the estimates were significant in both models. In Model 1, the

Table 5: RPL results

	Model 1		Model 2	
	Coef.	t-value	Coef.	t-value
Mean				
ASC_M	5.470***	9.371	1.480***	10.054
ASC_N	5.670***	9.020	1.768***	12.304
$Sample_B$×Euglena	0.450***	3.716	0.461***	3.578
Calcium	−0.251	n.a.	−0.283	n.a.
Vitamins	0.058	0.641	0.019	0.196
Euglena	−0.037	−0.416	0.028	0.291
Friends	0.267	n.a.	0.328	n.a.
Web	−0.593***	−4.927	−0.668***	−5.427
Tokuho	0.326*	1.668	0.339*	1.947
Amount	0.005***	4.375		
100 mg			−0.569	n.a.
200 mg			0.109*	1.754
300 mg			0.460***	3.773
Price	−0.038***	−8.314		
JPY 90			0.820	n.a.
JPY 110			0.006	0.071
JPY 130			−0.826***	−5.951
SD				
Web			0.465***	2.860
Euglena	0.985***	9.097	1.080***	8.266
Tokuho	−0.902***	−5.321	0.844***	5.000
Amount	0.007***	8.367		
300 mg			0.636***	3.585
JPY 130			0.857***	4.619
No. of samples	168		168	
No. of observations	1343		1343	
Log likelihood	−1017.200		−1041.000	
McFadden's ρ	0.166		0.147	
Chi^2 statistics	405.740		358.130	

Notes: *** and * denote significance at the 1% and 10% level, respectively. SD is standard deviation. The mean parameter for the omitted level of effect-coded variables calculated using the parameters of the remaining levels including the cross-terms with the $Sample_B$ dummy. n.a. = not applicable.

parameter was significantly negative. In Model 2, the size of the coefficient corresponded with the increase in the price. A negative estimated parameter corresponds with our economic intuition, and therefore we can estimate welfare measures such as willingness to pay.

5. Concluding Remarks

We investigated the checkbox positioning effect of CE by using an undergraduate student survey regarding a brand-new food commodity. The results suggested that there is only an effect on the top-placed attribute, and therefore we can alleviate the attribute of nonattendance when the checkbox is placed *below* the choice set, with the price attribute on the *bottom* in our case. However, we did not investigate whether this occurs when the

checkbox is placed *above* the choice set with the price attribute on the *top*. If this is done, we may observe a certain distance effect between the checkbox and the price attribute.

As discussed, attribute nonattendance for CM/CE is one of the more important issues to be addressed. Some studies have employed statistical inference such as the latent class model (Hess et al. 2013; Hole et al. 2013; Lagarde 2013; Glenk et al. 2015). Other studies have used the stated ignorance information from respondents (Hole et al. 2013; Kehlbacher et al. 2013; Nguyen et al. 2015). Yet other studies have employed eye-tracking techniques (Balcombe et al. 2015). In order to confirm the checkbox positioning effect on CM/CE, we should use such procedures to examine the relationship between the checkbox position and information processing by respondents. In particular, because the checkbox position is a geographical feature of the questionnaire, eye movements such as fixation and saccade will provide a good explanation for such positioning effects.

Nowadays, Web-based surveys are commonly used to elicit public preferences. Such techniques enable us to create survey instruments without a checkbox positioning effect. For example, a touch-panel survey instrument allows respondents to touch any of the alternatives in the choice set. Indeed, Liebe et al. (2015) suggested that employing mobile devices is not harmful for the survey quality of CEs. Therefore, we should develop survey instruments with tablet PCs in mind. In addition, we organized this research as a pilot study to elicit preferences of undergraduates for brand-new food products. We need to improve the design of attributes. For example, we may need to make allowances for alternative labeling such as ‘genetically modified’ or ‘fair trade.’ We leave these topics for future research.

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Appendix: Choice experiment scenario of sample B

"Suppose you want to buy a pack of chewing gum. Please choose your most preferred option from the following eight choice sets. When choosing, please consider the cost of each option. Meanwhile, assume everything else remains constant."

Sample answer when you prefer option N.

	M	N	L
Type of nutritional content	Euglena	Vitamins	I cannot choose between the two alternatives.
Recommended by	Web	Friends	
Amount of nutritional content	300 mg	200 mg	
Price (JPY/pack)	JPY 110	JPY 130	
	□	☑	□

Contents of alternatives

Type of nutritional content	The type of nutritional content of the chewing gum 1) Euglena: it contains 59 nutritional elements 2) Vitamins: it contains vitamins in general 3) Calcium: it contains only calcium
Recommended by	Those who recommended that you buy the chewing gum: 1) 'Tokuho': the chewing gum is proved to have particular health benefits scientifically, and is certified by certain authorities of the Japanese government 2) Web: the chewing gum was recommended by certain news or Internet blogs 3) Friends: the chewing gum was recommended by your friends
Amount of nutritional content	The amount of nutritional content of the chewing gum
Price (JPY/pack)	The price of a pack of chewing gum containing 14 pieces

Q1. How about the following combinations?

	M	N	L
Type of nutritional content	Euglena	Calcium	I cannot choose between the two alternatives.
Recommended by	Friends	Friends	
Amount of nutritional content	100 mg	200 mg	
Price (JPY/pack)	JPY 110	JPY 90	
	□	□	□

Q2. How about the following combinations?

	M	N	L
Type of nutritional content	Calcium	Euglena	I cannot choose between the two alternatives.
Recommended by	Tokuho	Tokuho	
Amount of nutritional content	300 mg	200 mg	
Price (JPY/pack)	JPY 110	JPY 130	
	□	□	□

Q3. How about the following combinations?

	M	N	L
Type of nutritional content	Calcium	Euglena	I cannot choose between the two alternatives.
Recommended by	Friends	Friends	
Amount of nutritional content	100 mg	200 mg	
Price (JPY/pack)	JPY 130	JPY 110	
	□	□	□

Q4. How about the following combinations?

	M	N	L
Type of nutritional content	Euglena	Vitamins	I cannot choose between the two alternatives.
Recommended by	Tokuho	Tokuho	
Amount of nutritional content	100 mg	200 mg	
Price (JPY/pack)	JPY 90	JPY 110	
	□	□	□

Q5. How about the following combinations?

	M	N	L
Type of nutritional content	Euglena	Vitamins	I cannot choose between the two alternatives.
Recommended by	Friends	Web	
Amount of nutritional content	200 mg	100 mg	
Price (JPY/pack)	JPY 110	JPY 110	
	□	□	□

Q6. How about the following combinations?

	M	N	L
Type of nutritional content	Vitamins	Euglena	I cannot choose between the two alternatives.
Recommended by	Friends	Web	
Amount of nutritional content	200 mg	300 mg	
Price (JPY/pack)	JPY 130	JPY 130	
	□	□	□

Q7. How about the following combinations?

	M	N	L
Type of nutritional content	Calcium	Vitamins	I cannot choose between the two alternatives.
Recommended by	Web	Friends	
Amount of nutritional content	200 mg	300 mg	
Price (JPY/pack)	JPY 110	JPY 90	
	□	□	□

Q8. How about the following combination?

	M	N	L
Type of nutritional content	Euglena	Euglena	I cannot choose between the two alternatives.
Recommended by	Web	Friends	
Amount of nutritional content	200 mg	300mg	
Price (JPY/pack)	JPY 90	JPY 110	
	□	□	□

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